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Application of Biofloc Technology (BFT) In Indoor Rearing of *catla-catla* (Indian Major Carp) with Different culture Methods

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Introduction:

World Aquaculture is growing annually ranging from 8.9–9.1% rate since the 1970s. This high growth rate is needed to solve the problem of shortage of protein food supply and which is particularly situated in developing countries. However, environmental and economic limitations can hamper this growth. Especially, intensive aquaculture coincides with the pollution of the culture water by an excess of organic materials and nutrients that are likely to cause acute toxic effects and long-term environmental risks. High-density culture in intensive systems requires high amounts of feed to be added to the systems.

This will cause water quality deterioration due to high concentrations of organic compounds. Since only 20-30% of feed are assimilated in fish and the remaining 70-80% of the feed will be accumulated in the water body as uneaten feed and excretory products. Ammonia is usually the abundant form of combined inorganic nitrogen in aquaculture ponds and it can be rather toxic to animals. Elevated concentrations of ammonia affect growth, oxygen consumption and even can eventually cause mortality of fish. Increased ambient nitrite concentration negatively affects the growth performance and survival of fish.

Biofloc technology (BFT) is an innovative technology that can solve the above problems. Biofloc is defined as macro aggregates composed of diatoms, macroalgae, fecal pellets, exoskeleton, and remains of dead organisms, bacteria, and invertebrates. Biofloc technology has become a popular technology in the farming of *Oreochromis niloticus*, *Litopenaeus vannamei*, *Macrobrachium rosenbergii,* and *Penaeus monodon.*

It was commercially first applied in Belize by Belize Aquaculture in North America. It also has been applied with success in shrimp farming in Indonesia and Australia (Taw, 2010) BFT is an aquaculture system that focused on more efficient use of nutrient input with a limited or zero water exchange system. The main principle of BFT is to recycle nutrients by maintaining a high carbon/ nitrogen (C/N) ratio in the water to stimulate heterotrophic bacterial growth that converts ammonia into microbial biomass (Avnimelech, 1999). The microbial biomass will further aggregate with other microorganisms and particles suspended in the water forming what has been called "biofloc", The pioneers of this technology include Steve Surfing, who established Solar

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Aquafarms in California, a shrimp and fish farm based upon developing active microbial suspension. Hepher, Schroeder, Moav, and Wohlfarth in Israel, developed the concept of the "Heterotrophic feed web" (Hepher, 1985).

In both cases, zero and minimal water exchange was practiced. Organic residues accumulating in the pond under such conditions degrade and ammonia - N is nitrified or assimilated, by an intensive microbial community. This series of processes replace the conventional external biofilter or high water exchange systems. In essence, the microbial processes within these ponds serve as the pond water quality treatment system and microbial protein serves as a feed additive. Biofloc technology facilitates intensive culture while reducing investment and maintenance costs and incorporating the potential to recycle feed. The technology is based upon zero or minimal water exchange to maximize biosecurity while minimizing external environmental effects.

Review of Literature

The environmentally friendly aquaculture system called "Biofloc Technology (BFT)" is considered an efficient alternative system since nutrients could be continuously recycled and reused. The sustainable approach of such a system is based on the growth of microorganisms in the culture medium, benefited by the minimum or zero water exchange. These microorganisms (biofloc) have two major roles: (i) maintenance of water quality, by the uptake of nitrogen compounds generating "*in situ*" microbial protein; and (ii) nutrition, increasing culture feasibility by reducing feed conversion ratio and a decrease of feed costs.

The objective of this chapter is to review the application of Biofloc Technology (BFT) in the aquaculture system and describes the utilization of biofloc biomass as an ingredient for compounded feeds (Mohamed Faizullah et. al, 2019)

Bioflocs are conglomerates of microbes, Algae, protozoa, and other organisms, together with detritus, dead organic particles. The biofloc is a unique ecosystem of rich and potent particles suspended in relatively poor water. The basic Principle of biofloc technology (BFT) is the retention of waste and its conversion to biofloc a natural food within the culture system. Now a day's biofloc technology has become very popular in the aquaculture sector. The concept of floc formation in activated sludge systems can be used for application in biofloc technology. The proximate

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composition, mineral content, energy content, and C: N ratio of biofloc produced from wheat flour as a carbohydrate source is presented. Biofloc contains 30% crude protein along with other essential minerals. An essential fatty acid is also Found in biofloc which is suitable for the dietary requirement of common carp. Therefore, it appears the developed biofloc can be successfully used as fish feed, particularly for herbivorous and omnivorous species.

The basic principle of biofloc technology (BFT) is the retention of waste and its conversion to biofloc as a natural food within the culture system. This can be achieved by constant aeration and agitation of the water Column and the addition of carbon sources as organic matter substrate to allow aerobic Decomposition and to maintain high levels of microbial floc in suspension in fed and/or fertilized ponds. Biofloc technology makes it possible to minimize water exchange and Water use in aquaculture systems by maintaining adequate water quality within the Culture unit while producing low-cost bio floc, rich in protein, which in turn can serve as a feed for aquatic organisms (Mahanand and Pandey,2019).

Biofloc technology is a technique of enhancing water quality in aquaculture by balancing carbon and nitrogen in the system. The technology has recently gained attention as a sustainable method to control water quality, with the added value of producing proteinaceous feed in situ. If carbon and nitrogen are well balanced in the solution, ammonium in addition to organic nitrogenous waste will be converted into bacterial biomass (Schneider et al., 2005). By adding carbohydrates to the pond, heterotrophic bacterial growth is stimulated and nitrogen uptake through the production of microbial proteins takes place (Avnimelech, 1999). Biofloc technology is a technique of enhancing water quality through the addition of extra carbon to the aquaculture system, through an external carbon source or elevated carbon content of the feed Biofloc technology makes it possible to minimize water exchange and water usage in aquaculture systems by maintaining adequate water quality within the culture unit, while producing low-cost bio floc rich in protein, which in turn can serve as a feed for aquatic organisms (Crab, 2010; Crab et al., 2007, 2009, 2010a). Compared to conventional water treatment technologies used in aquaculture, biofloc technology provides a more economical alternative (decrease of water treatment expenses in the order of 30%) and additionally, a potential gain on feed expenses (the efficiency of protein).

Utilization is twice as high in biofloc technology systems when compared to conventional ponds), making it a low-cost sustainable constituent to future aquaculture development (Crab et. al., 2012)

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Concluded that Biofloc technology offers aquaculture a sustainable tool to simultaneously address its environmental, social, and economic issues concurrent with its growth. Researchers are challenged to further develop this technique and farmers to implement it in their future aquaculture systems. The basics of the technology are there, but its further development, fine-tuning, and implementation will need further research and development from the present and future generation of researchers, farmers, and consumers to make this technique a keystone of future sustainable aquaculture.

In the aquaculture system, the major item of expenditure is feed which is about 50% of the total cost involved. Only 20-30% of the feed used in aquaculture is being assimilated by cultural animals and the remaining accumulates as a waste. The accumulated waste includes NH4+-N and/or NO2–N, which are toxic to the culture animals in a closed system. These toxic wastes can be effectively converted into useful nutrients by producing microorganisms by manipulation of carbon and nitrogen ratio (C/N) with biofloc technology. Common microbes associated with the flocs are Photoautotrophic microbe i.e. algae and heterotrophic microbes such as bacteria, rotifers, ciliates, protozoans, and nematodes (De Schryver et. al., 2008). The microbial community plays an important role in the biofloc system. Microbes are very important because they are a rich natural source of protein-lipid "in situ" available all day. They contribute in three main ways: i) water quality improvement ii) nutrition and iii) pathogen control, The maintenance of water quality, mainly by the control of bacterial community over autotrophic microorganisms, is achieved using a high carbon-to-nitrogen (C: N) ratio (Wasave et. al.,2019) conclude that Microbes play a key role in the biofloc systems. Microbes associated with floc after consumption help to improve digestion reduces FCR reduces dietary protein level and heterotrophic bacteria, which together probiotic bacteria, inhibit the development of potential pathogen bacteria. Also, the use of biofloc technology improves different aspects during cultures like higher growth rates, increased survival, improved water quality, reduced amount of water used and decrease in diseases and role of microorganisms is important in biofloc system. (Wasave et. al.,2019)

Biofloc technology is such a technology that can ensure sustainable aquaculture production, with low technical demands and it is available at a cheap cost. It is essentially a water quality management technique, through manipulation of microbiota to convert the deleterious waste from aquaculture production to consumable body biomass and it has been established to have many other benefits asides from the intending water quality. This review discusses the developments of

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biofloc technology, microbial interactions, important operational parameters, and implication of the system to the disease and health management of cultured aquatic animals. The basic operating principle of this system involves stimulating the growth of bacteria to remove nitrogenous waste by increasing the carbon/nitrogen ratio, mostly by the addition of an organic carbon source (Avnimelech, 1999).

(Daude,2019) concluded that BFT is potentially a sustainable aquaculture production system with so many benefits, which will not only lead to reduced environmental pollution but also increase production, the resistance of the cultured organisms to disease, and increased profitability to the farmers. However, the effectiveness of this system depends on the level of understanding of the principle of operation, microbial interactions in the system, and the ability to manipulate the important parameters to suit the needs of the target organism to be cultured in the system. Carbon sources and ratio have been established to be very important parameters in BFT (Daude,2019)

Objective:

- To development of Biofloc system using different carbon sources.
- To analysis of water from Biofloc system.
- To study probiotic /microbial analysis of Biofloc by using the standard method.
- To study application of Biofloc in the enhancement of *Catla catla* fish production.
- To study biofloc fish disease and immunological parameter.
- To Study common bacterial causing fish Diseases.
- To study of different rearing techniques and their effect on the growth of fish.

Methodology to be adopted:

- ✓ Collection of samples from fish seed production center.
- ✓ Monitoring of collected samples in the tank by using different carbon sources.
- ✓ Sampling for fish growth and biomass monitoring will be performed in week.
- ✓ Water analysis by standard methods with DO, pH, TAN, TTS.
- ✓ Identification of probiotics and microbes from the biofloc system.
- ✓ Estimation of the nutrient's from probiotics.
- ✓ Bioflocs proximate analysis.
- ✓ The calculation for fish growth parameters with statistical analysis

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Significance of study:

- Benefits of Biofloc culture system
- Eco-friendly culture system.
- It reduces environmental impact.
- Improves land and water use efficiency
- Limited or zero water exchange
- Higher productivity (It enhances survival rate, growth performance, feed conversion in the culture systems of fish).
- Higher biosecurity.
- Reduces water pollution and the risk of introduction and spread of pathogens
- Cost-effective feed production.
- It reduces the utilization of protein-rich feed and the cost of standard feed.
- It reduces the pressure on capture fisheries i.e. use of cheaper food fish and trash fish for fish feed formulation.

Importance of Biofloc Technology

International level:

With almost seven billion people on earth, the demand for aquatic food is increasing accordingly, and hence, expansion and intensification of aquaculture production are highly required. Aquaculture as a food-producing sector offers ample opportunities to alleviate poverty, hunger, and malnutrition, generates economic growth, and ensures better use of natural resources (FAO, 2017) Aquaculture production is projected to rise from 40 million tonnes by 2008 to 82 million tonnes in 2050 (FAO, 2010) World aquaculture has the most increase in the last 10 years the management of technology good condition for fish production in aquaculture the fish production depends upon the physiochemical and biological water quality in the promotion of aquaculture growth and researcher that focusing the understanding of water quality and building system knowledge is very important by using biofloc technology is a system that increasing at a culture production by using microbial technology

The scientific and practical concepts of BFT evolved concurrently and independently at about the same time by Steve Hopkins and co-workers at the Waddell Mariculture Center, South Carolina, and by Avnimelech and co-workers in Israel (Avnimelech, 1993; Hopkins *et al.*, 1993; Avnimelech *et al.*, 1994; Chamberlain and Hopkins, 1994).The pioneers of this technology include Steve Surfling,

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first applied in Belize by Belize Aquaculture in North America. It also has been applied with success in shrimp farming in Indonesia and Australia (Taw, 2010).

Continuous growing of human population and production of the food industry in case of aquaculture nowadays to need to expand to preserve the environment and the natural resources is the expansion to need conserve in suitable ways that are biofloc system this technology is a milestone for production increasing aquaculture.

The practice of rearing for decreased aquatic animals in the biofloc was established risks in many countries. Today, this technology is free from pat productively successful in commercial shrimp biosecurity farming to the countries including Asia, China, the presence of r America, Italy, Brazil, and South Korea. Besides a role in the most of the universities, colleges, and research to attain more centers are currently work.

National level:

Fish, which accounts for more than 7.5% of total world food production, is the 5th most important agricultural commodity. India stands second in terms of aquaculture production in the world with 10.79 million metric tons from 6.9 million hectares of freshwater area and 1.24 million hectares of brackish water area (NFDB, 2016-17). India's seafood export was valued at US$ 4.7 billion (MPEDA, 2016-17). As the aquaculture industry intensively develops, its environmental impact increases. Another important aspect of this process is the potential utilization of microbial protein as a source of feed Protein for fish or shrimp.
Biofloc technology (BFT) is considered the new "blue revolution" in aquaculture. The concept of the rapid increase in the production of fish and marine products through package programmed is called as blue revolution. It was launched in India during the seventh Five-year plan (1985-1990) when the Central Government sponsored the Fish Farmers Development Agency (FFDA). It has brought improvement in aquaculture by adopting new techniques of BFT, fish breeding, fish rearing, fish marketing, and fish export. Biofloc technology is an innovation that has been applied in aquaculture to reduce feed cost and ammonia in the system by recycling the nutrients, leftover feed, and fish wastes.

Biofloc technology is reliable for the cost advantage effective, environmentally friendly fish production minimal cost it is a preferred technique for facing the economic, pollution ecological, and social issues relevant to currently guaranteed aquaculture. The system has an advantage in of water is intensive farming practices. The practice of rearing for decreased aquatic animals in the biofloc was established risks in many countries.

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Proposed work plan/ Formulation and structure of study:

First-Year: Course work Literature survey, Fish seed collection for experimental work.

Second-Year: Development of Biofloc system using different carbon sources. Probiotic/microbial analysis of Biofloc by using the standard method. Application of Biofloc in the enhancement of fish production yield.

Third-year: To study the role of Biofloc technology in controlling Fish disease and immunological parameters. Analysis of water from Biofloc system.

Fourth-year: Resulting and data analysis, publication of research paper, thesis writing, and submission to the university.

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